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## How to avoid that cow manure

THE computer industry is, as we all know, full of jargon and clichés (vide Angus McQuibb article, CW, October 12). It also has a tendency for the vulgar term for which can, for polite company, be expressed as "cow manure".

To anyone in the industry there are certain facts which are commonly assumed, such as the gross overselling of systems in the Sixties where there was little evidence available to seller or buyer that the systems could do what they were supposed to do.

As humorously illustrated in Programmer Notes (CW, November 2), project management of systems implementation has almost inevitably led to failures to meet deadlines and when the deadlines are met, it is usually found that there is a fault in the systems design which falls to take into account some aspect or other of user requirements.

The communications media, including the Press and conference organisers, sometimes play a role in the cow manure process by identifying, writing about, talking about and providing learned papers on important issues such as database, the micro revolution, etc.

Like those ordinary men who might read the letters columns of magazines such as Penthouse

and Forum and wonder "Why am I missing out?", people in the industry might well be led by the stream of information on the latest techniques (brought to a white heat by salesmen trying to achieve their budgets) to a desire to emulate the supposed achievements of others.

Putting on and taking off trends with the tempting speed of Penthouse models and their clothes, the computing industry has already lived through such "golden oldies" as database management systems and distributed processing and is now into micros and word processing, which are on the brink of becoming a bit old hat. There are also recurrent raves from the graves, like the much announced death of the punched card or dawn of the OCR era.

Yet few users, for example, can point to genuine database systems or distributed processing networks; genuine in terms of philosophical design aims, not practical muddling through.

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and Forum and wonder "Why am I missing out?", people in the industry might well be led by the stream of information on the latest techniques (brought to a white heat by salesmen trying to achieve their budgets) to a desire to emulate the supposed achievements of others.

In all this, it is difficult to point the finger of blame at any particular group, for generally each group in isolation is doing its best in a complex, changing world.

DP departments have a tough time reconciling their user needs with their resource and technological capability, and manufacturers have their crusts (plus butter and jam) to earn.

Journalists and conference organisers also have a hard job pointing to the future while keeping up with today.

So, what can be done about all this? One bit of action could be to lash out on all sides and cry Woe! and Shamel as did the recent BCS report on User Requirements in DP (CW, November 2).

The vague conclusions of this report are worthy of notice, but too nebulous to be put into practice.

In practice, the only solutions (if any) will be found, firstly, when there is an improvement in

the educational level throughout the country, particularly among managers, on the subject of the reality behind the computing cow manure; and secondly, when the computing professional starts seriously attacking the question of good, reliable, user-oriented systems design.

On the wider awareness issue, there are signs — such as the Department of Industry micro education scheme, and awareness among unions and training agencies of the importance of this issue (CW, November 2) — that those responsible for implementing the action are getting the message.

On the question of improved professional standards, responsibility rests on all those who run and develop systems to take action.

And it is to be hoped that an obligatory part of any training course relating to computing will include a guide on how to identify and avoid cow manure.

DP personnel should also be protected from the user — especially where late completion of their new applications are involved.

Thinking the blame has become an accepted part of the DPM's life. Perhaps it is time that some of the blame was contracted round the industry.

In many cases, it is sheer disinterest which motivates the DPM in his neglect of the small print. Often, though, it is wilful puzzlement as to what it all means.

All too often, the procedures and regulations governing any particular contract can be overruled by the law of the land. Interfacing industry contracts with relevant legislation takes more than a single file sort.

Maybe it is time for instilling management to issue some contracts of their own. These would be produced on standard print-out listing with a clause exempting any "bugs" which might have escaped notice. The first clause would exempt the installation from any equipment misbehaving by the DP team. While every endeavour would be made to keep the novice operator and/or computer trolley under control, subsequent responsibility is limited.

Smoke detectors are notoriously sensitive and even the best maintained system has been known to trigger related fire sprinklers — particularly on Friday nights after everyone has gone home. Suppliers should also make allowances for such everyday happenings as split coffee on the control panel or anti-static polish on the disc

## MAI take over Basic/Four in UK

AIMING for a rapid growth in the UK market share, MAI has acquired its UK distributor, Four (UK) Ltd (CW, Nov. 28).

There are three main MAI's US business: Basic, Corp, which manufactures a range of micro systems under the name of Sorbus, a US-wide maintenance company, WordStream Corp, which manufactures shared processing systems.

Together with the two subsidiaries in Germany, Switzerland and France, MAI is a \$20m company.

MAI's main UK market is immediate future will be Basic/Four systems, of which there are four models, 410, 610 and 730. There are different processors, around MAI's proprietary operating system which is optimised to run Basic/Four efficiently. Basic/Four is a language offered.

The company used to produce the Microdata 1800 in 1974, which it started to build in 1975.

Typical configurations for the Basic/Four: 32K-byte processor, 10 Megabytes on disc, 10 printer, cartridge tape drive, system software costing £24, a 410 with 56K-byte processor, 160 chips printer cost £3, and at the top end, the System 730 with 8192, 150 Megabytes on disc, 10 printer costs £59,000.

## IBM's charging for software 'could backfire'—Magnuson

THE policy change at IBM under which users will be charged for all newly introduced system software and software enhancements could well backfire on the company. That is the view of Paul Magnuson, founder and chairman of Magnuson Systems Corp, the company established to design, manufacture and sell a radically new kind of plug-compatible processor.

"There are many little software companies out there just waiting for IBM to give them the opportunity to get into the system software business," he told Computer Weekly.

"By giving away the software, IBM has been able to achieve its objective of having one common centralised system control program for all customers. But as soon as it starts charging more than about 10% of the hardware price for software, it will let the independents in. At 20% of the hardware price, a number of independents will start competing; a 40-50% price would let the whole world in."

The risk has not gone unnoticed at IBM. Individuals have indicated in private that they are very worried about the problem, and are uncertain about the right approach.

With IBM's extremely aggressive pricing policy on its newest hardware products, particularly Systems 38 and 8100, the company appears to have decided that it must get a bigger return from software, but Magnuson underlined the dangers graphically.

"It takes, say, \$20 million to market the M80 series of IBM-compatible desk-sized mainframes in European airlines. Target applications are cargo services, engineering, reservations, back-up, ticketing and departure control, and reservations for smaller airlines."

A second Intel company, Magnuson Middle East, has been formed to sell throughout the Middle East and North Africa. The agreements do not preclude Magnuson from signing other European agents.

The first M80 mainframe was shipped to Fairchild, the company which has a 32% stake in Magnuson. The second has gone to Mitrol Corp of Boston, which markets a manufacturing software package and previously used the National CSS bureau.

Both were M80-4s, which are aimed to offer between 20% and 40% better performance than the 370/148, depending on applications.

Magnuson is currently producing one machine a fortnight. By January output will be one a week.

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## NatWest DP chief

OVERALL responsibility for data processing and clearing operations at National Westminster Bank will soon be in the hands of Cyril Townsend, a former managing director of NatWest's Centre-film bureau, who is to become general manager of the bank's management services division on December 31.

He is currently chairman of NatWest's computer output microfilm bureau subsidiary, Eurocom Data (Holding) Ltd. Townsend's new job will include responsibility for NatWest's new London Management Services Centre at Goodmans Fields, near Aldgate.

## 3,000 lpm impact printer talking point of Compec

AN impact printer running at a mind-boggling 3,000 lines per minute promises to be one of the prime topics of gossip around the bars and restaurants of Olympia next month.

The printer, called the DOC 3000, will dominate the Documentation stand at the biggest and best Compec exhibition staged so far. The DOC 3000 uses bond technology, and is offered as a low-cost back-up device to the IBM 3800 laser printer.

Compec, in the National Hall, Olympia, will open on Tuesday, December 5, and close on Thursday December 7, and those wanting to attend should apply immediately for free pre-registration tickets to avoid having to pay £2 on the door. Applications should reach Compec Tickets, Room 821, Dorset House, Stamford Street, London SE1 9LU not later than November 22.

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## Downtime by Chad

### Ruthless EOJ routine

I KNOW Americans have a reputation for being ruthless, but it's seldom one gets such a graphic experience of this first hand as I had when I was visiting Los Angeles recently. I was standing in the queue for the hotel desk when I noticed the two out-of-state American gentlemen in front of me were having difficulty with their reservation. They insisted that the booking had been made by their firm. Eventually the manager was called, and he arrived carrying a telex sent to the hotel by their "employer."

"This," said the manager, waving the telex before them. "says that the reservation has been cancelled because you don't work for them any more."

What a way to give someone the sack! The last I saw of the two gentlemen, they were being ushered away to the manager's office in a state of understandable shock. Remember that, the next time you complain about your heartless employers!

### Fit of the gigos

THE DP industry is getting old enough now for people to reminisce about the Good — or Bad — Old Days. An acquaintance of mine was talking about his years in the late Fifties at an IBM installation at a drug company in Hounslow. They were having a lot of difficulty with accuracy of input data, and he set about investigating the staff selection procedures.

Among the denizens of Hounslow, it appeared that those school leavers who could get good jobs would travel to central London for these. Those left would be employed by this firm to deliver the internal post.

Of these, the girls who kept leaving the letters at the wrong offices, or dropping them down the drains, were put in the post room sticking stamps on letters.

Finally, those who kept putting the stamps on the wrong corners, were made damn prep operators.

The management, of course, were very impatient with the computer, which didn't seem to be delivering the goods. To paraphrase the old tag, "Who prepares the data preppers?"

## Participative systems design

A BCS survey of DP user requirements was highly critical of the failure of systems designers to include the views of all users in their design specifications (CW, November 2).

A technique of participative systems design aimed at overcoming this type of criticism has been created by three specialists in computers and systems management, ENID MUMFORD of the Manchester Business School, FRANK

LAND, senior lecturer in computers and systems analysis at the London School of Economics and JOHN HAWGOOD, director of the computer laboratory at Durham University.

Their technique sprang from a project initiated by the National Computing Centre about eight years ago to look into the economics of computer systems. The more they looked into this subject, the more they realised it depended primarily on

the way the system was designed.

These techniques have now been implemented at a number of user sites and specially commissioned series of five and six, Mumford, Land and Hawgood will describe the technique, drawing on their implementation experience of the technique, which they call "new design methods to cater for the climate of democracy in industry."

# Taking users' needs into full account

DESIGNING systems is a complex and demanding process. Designing systems for a new and rapidly developing technology is also an evolutionary process, one which involves constant learning as new or changing needs are identified in the system environment, and as intellectual approaches which worked well at one time cease to be effective or another.

The design of computer systems today is being increasingly influenced by major social and technical changes. Socially, there has been a shift of power from the top to the bottom of most organisations. This has been accompanied by increasing demands for involvement in decisions that affect lower level workers on the shop floor or in offices and a willingness to use employee power to block change which is viewed as undesirable or disadvantageous, in particular change which is seen as leading to a reduction in jobs.

Technically, the advent of microprocessors, while increasing the potential scope and flexibility of computer systems, seems to some to augur a realisation of the worst employment fears of the past.

The design of computer systems is therefore increasingly becoming a negotiating process in which all interested groups require a role in the analysis of needs, setting of objectives and design activities.

For many types of applications the day of the lone systems designer is over. Therefore new design methods are required to cater for the new climate of democracy and to ensure that users receive the kinds of systems that meet these needs, because they have had a responsibility for the design of the systems.

We have over the past few years been developing a philosophy of system design and forward planning based on staff and user participation and a set of procedures to assist the participants. These will be outlined in this first article and discussed in more detail in four subsequent articles.

All systems design is influenced by people's values and philosophy. Top management values will influence the kind of

ward planning based on staff and user participation and a set of procedures to assist the participants. These will be outlined in this first article and discussed in more detail in four subsequent articles.



Enid Mumford

strategies they use to ensure the economic viability of their organisations and the nature of the human relations climate they wish to create for their staff. The values of the computer professionals will influence the kind of system objectives they set and the importance they attach to such human needs as job satisfaction.

The values of user groups will influence the manner in which they respond to computer systems and their enthusiasm or reluctance to ensure that they work. But values today are in a state of flux, and this is one reason why there is pressure to reformulate these and to develop the new approaches and techniques that will fit a new, and more humanistic, set of values.

The management values of the past have tended to see labour as an expendable, easily replaceable commodity which produces at highest efficiency and lowest cost when few demands are made on it, when work is tightly controlled and when little or no discretion is allowed to the individual worker or to the work group. These values, together with the dominance of a technical ethic, influenced the design of many early computer systems.

Sackman describes the systems design scene of the 50s and 60s in the US in the following way:

"The developing computer ethos assumed an increasing misanthropic visage. Technical matters turned computer professionals on human matters turned them off. Users were troublesome petitioners somewhere at the end of the line who had to be satisfied with what they got, because after a substantial investment, they usually couldn't go elsewhere."

The situation of the 1970s has been very different, but still apparently unsatisfactory. In Britain most systems designers have tried very hard to meet user needs and provide the kinds of systems that users will welcome and appreciate, but frequently they have failed to do this and have been met with a hostile reception from management and subordinates alike.

Can our method help improve this state of affairs? We believe it can, and now have experience of testing it out in six different organisations: a savings bank, a public library, an insurance company and three industrial firms. It is also being applied by groups in Germany and the US.

The approach is based on a clear value position, which can be stated in the following propositions:

1. That the individual's work

and work situation can and should be set up in such a way that he or she can do a job that is personally satisfying in a safe and comfortable environment. (The computer can and should be a means for assisting this.)

2. That everyone affected by a system change, including users, customers, management and technologists, can and should be considered in planning it.

3. That employees at all levels can and should analyse their own and their clients' needs and design their own work systems.

4. That the overall approach to systems design and development can and should be based on the approach of enabling the organisation, the group and the individual to cope better with uncertainty.

The argument behind these statements is related both to ethics and to expediency. We believe that people have a moral right to influence the organisation of their own work situation and also that if this right is conceded then there are likely to be gains both in job satisfaction and in efficiency.

Job satisfaction gains, because the group whose job satisfaction is going to be affected by any change is better able to diagnose its own job satisfaction needs than is any outside group of specialists.

Efficiency gains, because the people who are in the change situations are likely to have an excellent knowledge of day-to-day work problems and can make useful contributions to the solution of these.

If users are going to participate in the design of their own systems, then they need both a structure to assist their participation and a set of simple analytical and design tools. These will be described in our next three articles.

Briefly, the participative

approach involves first creating a structure to assist consideration on long-term company strategy. When organisational objectives have been set, a broad system covering all of departments is being developed, then a design group, representatives of all the areas in these departments created.

Lastly, when a sub-system and local procedures are designed for a particular department or section, a design group is created, staff being involved in decision-making. Both of design groups report to management and make officials.

The tools used by the design groups to acquire design and evaluate:

1. A method for identifying current efficiency problems;

2. A method for identifying satisfaction needs and requirements;

3. A method for identifying significant trends and opportunities;

4. A method for identifying development goals important to different interest groups;

5. A method for assessing likely benefits of different strategies to different groups. This assists the choice of effective course of action acceptable to all groups;

6. Detailed socio-technical systems design to ensure the final system meets both as well as technical and administrative objectives.

The final article will describe our existing approach to indicate developments we are now working

Part

## Banks see big savings in cheque scanning system

THE massive cheque handling workload borne by clearing banks could be substantially lightened by a system that captures and processes electronic images of cheques. The system is called Bancr, a name which combines the names of its joint developers, the Bank of America and NCR.

No details have been released yet either of the hardware or software components of the Bancr system, but one of the known essential features is a terminal that will be installed at each bank branch and which will be used to scan both sides of each cheque deposited at the branch, transmitting the image

to a regional cheque image sorting centre serving, typically, about 50 branches.

The system at the centre will be capable of extracting information that requires computer processing, like the amount, from the rest of the image and displaying it so that an operator can capture it for DP purposes. The information could then be transmitted to the bank's computer centre.

The system should also be able to sort images. In the case of images of cheques drawn on accounts at branches belonging to the same bank, sorting would include sorting into branch order. The images would then be

transmitted to the appropriate branches.

Images of cheques drawn on branches of other banks would be outsourced or could be transmitted to the Bancr networks of the banks involved. If such networks existed.

In this way Bancr would be a viable and more acceptable alternative to the Electronic Funds Transfer System, EFTS, concept where cheques are totally eliminated, because Bancr dramatically reduces the amount of cheque handling, while enabling the customer to continue using his cheque book.

Banks in the UK see the biggest

benefit of Bancr being the elimination of the need to sort actual cheques and transport them physically to the branches they are drawn on in order that the signatures on them can be verified.

Some of the benefits of Bancr anticipated by the Bank of America include reduced energy and fuel consumption, reduced paper consumption and the increased ability to handle rising cheque volumes without sacrificing speed, accuracy or control. Bancr would reduce or greatly alleviate the problems caused by individual cheques being misplaced.

The Bancr development effort within NCR is concentrated at the company's special systems development centre at Torrey Pines, near San Diego in California. Problems being tackled there include extracting information from "picture" cheques, where the decorative picture can be confused with the relevant information on the cheque.

## Castell's new venture offers scheme to assist young growth companies

YOUNG, growing firms in the information technology field can now turn to a new company, Castell Computer & Systems Telecommunications Ltd, of Witham, Essex which has been started with the ambition of trying to help new technology-based firms.

Established by Dr Stephen Castell, a long time campaigner for the provision of venture and development capital for new technology-based firms, the new company is acting on behalf of a

He explains his scheme by pointing out that, "This type of private company, particularly that in the computer services industry, frequently finds itself frozen out of the conventional sources of equity and loan finance or, if it manages to find

CASTELL can be contacted on 0821 951776

accommodation it is often on only severely disadvantageous terms to the, typically, founding and still-managing technological entrepreneur owners. Paradoxically, such a company can often show spectacular growth rates with the right sort of development finance backing."

The new scheme, he claims, will overcome some of the "classical difficulties" associated with financing small, new-technology private companies by "floating" a proportion (usually between 20% and 49%) of existing or new shares, or a mixture, on the new Over The Counter "Exchange" Market into the hands of a wide spread of individual investors.

Castell emphasises that this will be carried out by his clients who are very experienced in these matters, with the utmost caution and attention to the regulations governing the issue of such securities.

The Offer Document will be particularly clear and comprehensive and have something like "Danger—You Are Entering a High-Risk Investment Area. Widows and Orphans with Life-Savings Keep Well Away" printed clearly on its cover" he commented.

The subsequent responsibilities of the "floated" company will be kept to a minimum. It is fundamental to the scheme that the existing management will be left largely alone to get on with the job of attaining the performance set for their company made possible by the new finance, although obviously a

certain minimal amount of continuing reporting to the new shareholders would be required.



CASTELL... "overcoming some of the classical difficulties."

company of licensed securities dealers in offering a scheme to assist young growth companies.

Dr Castell, who worked for international merchant bankers, Bremer Holdings until earlier this month, told Computer Weekly that the kind of growth company he is looking for, typically has a turnover of between £150,000 and about £500,000 and is currently operating at break-even but has signs of rapid growth to annual turnover and profits of about £5 million and £500,000 within two to three years.

Capital in tranches of between £50,000 and £500,000 is available, according to Castell, and a company's shares may be valued on the basis of about two to three times projected earnings.

## Guardian OS extended

A SUBSTANTIAL extension to the Guardian operating system allowing Tandem 16 NonStop computer systems to be linked in distributed networks, has been announced by the company.

Called Guardian/Expand, the key feature is that the same automatic sharing of programs and applications which takes place in a local multiprocessor Tandem system can now take place in a distributed network. According to Tandem the only difference which will be observed by the user is a slower response time from remote applications than from local ones.

Tandem currently has some 240 processors installed with 80

customers worldwide, and did about \$25 million of business in the year ended September 30.

In the UK, the company has received two orders from Barclays and two from the Ministry of Defence. The Barclays system are one dual-processor handling foreign exchange dealing, and another acting as controller for a worldwide asynchronous point to point communications system connected directly to the channel of a twin IBM 370/158 system in IBM 2780 emulation mode.

One of the Ministry of Defence systems is to be used for code-breaking at Government Communications Headquarters, GCHQ, in Cheltenham.

## Exam papers contract

A CONTRACT worth £77,000 for automatic marking of 700,000 exam papers has been completed by Lewden-Alex, the Croydon bureau, for the Matriculation Board of Nigeria.

The exam answer sheets, submitted by 100,000 students, each contained multiple choice answers to 100 questions. The huge task of marking them, and from the results assigning to the

students the 20,000 university places available, was given to Lewden-Alex after the Matriculation Board had seen the bureau's advertisement in Computer Weekly.

In addition to calculating each student's mark, the computer system had to apply standardisation formulae to bring the levels of 18 different examinations into line.

## DEC announces 3271 interactive software link

AN IBM 3271 protocol emulator has been announced by DEC for the PDP-11. The software makes the PDP-11 resemble a 3271 terminal controller, with each minicomputer task acting as a terminal to the mainframe.

Programs running under RSX-11 and IAS can thus communicate interactively with programs running on a System 360 or System 370 host.

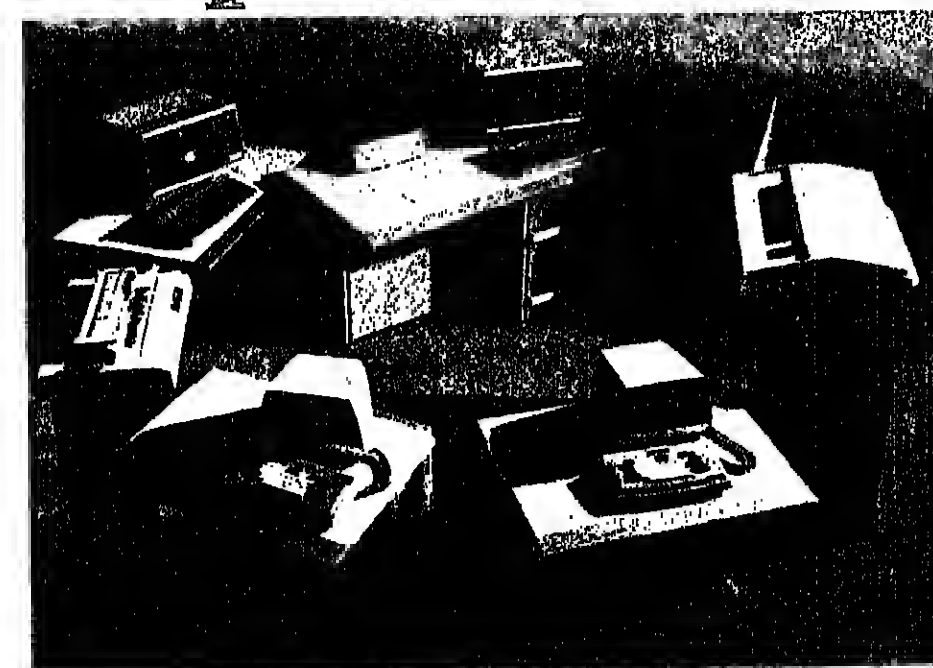
PDP-11s using the protocol can share a multi-drop line with other devices using IBM's BSC communications protocol. The other devices can include true 3271 controllers as well as other

PDP-11 emulators. Priced at £3,050 with full documentation and support, the package can also be purchased unsupported for £2,025. Multiple-sale licence-only price is £1,215.

## Ulster rights

HAVING gained no satisfactory agreement with Queens University, Belfast, over negotiating rights for its 350 members there, of whom 60 are computer staff, ASTMS has passed the dispute to the Labour Relations Agency, the Ulster equivalent of ACAS.

# GMC SOVEREIGN here, now, for power and performance



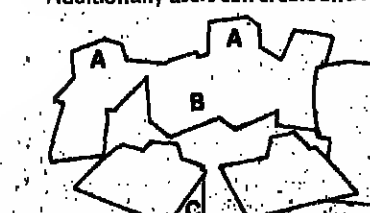
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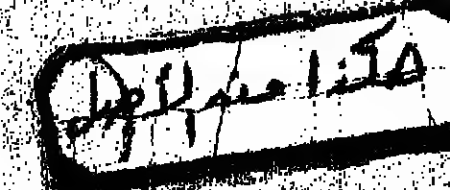
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# MICHIE'S PRIVATEVIEW

Where the  
genius of  
calculating lies



THE one thing that a calculating prodigy is not particularly good at is calculating. Yet in a very precise and well documented sense, that is the fact of the matter.

There is a general truth about the nature of highly trained intellectual skill, which seems a little obvious once it is stated, namely that if you are obliged to operate on problems with a computer made of jelly, you are likely to develop rather strange computational strategies.

Facts such as the one cited above seem to administer a jolt nonetheless. People forever slip back into the assumption that the brain's raw bit-handling capacities, in the case at least of sufficiently gifted and trained practitioners, are the equal of at least an 80 mips Cray-1 machine. I call this the "van Dusen delusion", after the hero-detective of the early French thrillers of Jacques Futrelle.

Reviewing one of these (in "Bloody Murder") Julian Symonds tells us the following:

"He (Professor Augustus S. F. X. Van Dusen) is introduced to us when he refers contemptuously to chess, saying that a thorough knowledge of the rules of logic is all that is necessary to become a master at the game, and that he could take a few hours of competent instruction and defeat a man who has devoted his life to it. A game is arranged between the Professor and the world champion, Tschalkowsky. After a morning spent with an American chess master in learning the moves, the Professor plays the game. At the fifth move Tschalkowsky smirks smiling, and after the fourth, when Van Dusen says 'Mate in fifteen moves, the world champion exclaims: 'Mon Dieu! (he is not one of those Russians who knows no language but his own), and adds: 'You are not a man; you are a brain — a machine — a thinking machine.'"

To calculate a mate in fifteen knowing nothing but the move would occupy the Cray-1 for something like 10<sup>30</sup> years of continuous running. The age of the solar system is but a flash by comparison, a mere 10<sup>10</sup> years or so, so that it is hard not to feel sympathy with Tschalkowsky. Had he known more physics Tschalkowsky would have realised that the great detective's performance was not just superhuman but actually supernatural, since limitations to do with the speed of light and the atomic dimensions of matter decree that NO machine could ever perform the feat which he had witnessed, not even a "thinking machine".

Although the van Dusen delusion is at its more rampant in the matter of processing power, the onlooker tends to endow the expert's brain with equally impossible properties also of store. Just as lightning calculating prodigies do not calculate any faster than you or me, and chess-masters do not analyse numbers of moves in the forward tree of possi-

ties, so the professional memory men electrify large audiences without in fact having any better or worse raw memory than the next man. Somehow the audience convinces itself that the performer is actually storing and addressing each atomic item, just as though he had some vast 10<sup>10</sup> bit RAM inside his skull.

Larry Lorayne in his "How to develop a super-power memory" opines that anyone can acquire the same gift just by working hard enough to study his mnemonic rules, or any similar mnemonics. Such rules centre round the systematic formation of associations for pairwise linking of concepts, coupled with the use of imagined sequences of events, ie stories. This latter was regularly exploited by ancient Greek orators for learning a speech.

The textbooks on rhetoric advised reading through the speech while perambulating accustomed terrain, one's house and courtyard for example. Each time the speech was conned, the same journey would be made, until each sentence was tagged by association with a familiar spot.

When finally launched on the speech the orator need only imagine himself sauntering over the route, and as in his mind's eye he passes each familiar sight, the corresponding passage of text is triggered from memory.

Ridiculous, weird, obscene, violent and generally far-out images make the best associations. Suppose that my private mnemonic code for the first ten numbers is "Nought is for sport; one is a bun; two is a shoe; three is a tree; four is a door; five is a hive; six is a Weatib; seven is Heaven; eight is a date; nine is for wine", and someone speaks fairly slowly the following number to me with the idea that I should later recall it: "803, 735, 204, 381, 682". The memory-man's approach is to put together a rapid mental scenario as the digits are spoken, something like this, say: "I have a date with an all-in Wrestler but she gets up into a tree thinking to take it to heaven, but falls out of the tree onto a bee-hive getting bees into her shoe which sting so that she breaks the high-jump record through the door of a passing plane which crashes on the tree so I have my date again and start with a bun for the two of us with Weatib and wine which she pours into her shoe drowning the bees so all end happy."

The fact that the extemporised story is violent, childish, bad-taste, grotesque and otherwise embarrassing will prove to be a strength if some weeks from now a reader should suddenly say "What was that fifteen-digit number?" "Would it have been 803, 735, 204, 381, 682?" I will reply innocently, as my in-

eye follows that muscle-bound lady through her appalling antics.

To mention a few tricks of the trade is only to graze superficially the deeply worked territory of the memory men. But the principle is not in doubt. Their amazing achievements, just as those of a Grandmaster in remembering chess games of his own and others, are not attributable to the Creator's having handed them some special piece of hardware. Prima facie tests of a Grandmaster's power to recall briefly-glimpsed chess positions seem, it is true, to indicate possession of special equipment. But try randomly permitting the pieces on the board before the brief glimpse. Robbed of the meaningful associations with which, for him, a chess position overflows, the gift promptly deserts him.

So too with calculating prodigies, of whom the greatest was probably the late Professor Alexander Aitken, the Edinburgh mathematician. In his published study of Aitken, Professor Ian Hunter remarks that

"A number is apprehended (by Aitken) as a multiplicity of numerical attributes and, so to speak, as bristling with signalling properties... This simultaneous, immediate apprehending of numerical attributes is often automatic in that no specific preparation is necessary. For example, on one occasion the thinker heard the year 1981 mentioned, and apprehended this as 37 times 53, and 44 squared plus 5 squared, and 40 squared plus 19 squared."

This power to apprehend attributes in a flash, reminiscent of a Grandmaster's glimpse of a chess position, was the basis of what Hunter called the "First phase". Aitken's response to a problem was divided into two phases. During the first he was occupied in rummaging through his well stocked pattern-memory for components with which to synthesise a calculative plan. During phase 2, or "run time" as we might say, he was executing the plan by doing the specified calculations in sequence. But the sequence proceeded, as measured by the rate at which he uttered successive digits of the solution, at roughly the same speed at which anyone else would have performed it.

So calculation itself is not where the calculating prodigy's genius lies. Program synthesis, not the program, is the heart of the matter.

Reference: Hunter, I.M.L. (1992) An exceptional talent for calculative thinking. Brit. J. Psychol. 83, 243-258.

Donald Michie

## SOFTWARE FILE-1

# BP buys package for Jackson method

A COBOL pre-processor which supports the Michael Jackson structured programming method has come into the limelight with the sale of the package to BP. And Michael Jackson Systems is preparing to market the software more actively.

JSP-Cobol generates a Cobol procedure division directly from Michael Jackson's design language. It was installed by BP late last year on trial at its Harlow site, and has now been bought for use on its Univac computers.

A spokesman for Michael Jackson Systems said the package had been in existence for about two years. It had seven or eight users, the longest standing being International Stores.

With one exception, the software left the first three divisions of a Cobol program unchanged, he said. However, the procedure division was radically different; pre-processor input here consisted of a list of operations together with design language specifications of the processing structures.

The pre-processor, he said, should not be regarded as a way of generating Cobol more quickly. Rather the input should be treated as a higher level language in its own right. Maintenance, for example, should be performed on the design language, not on the Cobol.

"If people are going to mess around with the generated Cobol, then they have failed to

understand the Michael Jackson design method," the spokesman observed.

He added that the package automatically performed a number of optimisations, particularly those concerned with saving space. For example, where several SELECT options shared the same end-action, the software would generate a common action-tail, branched to with GOTOs.

Mostly written in JSP-Cobol itself, the package includes pre-coded in assembler. It is thus fully portable, being available currently for Univac 1100, 44 IBM VS, OS, and DOS systems. A version for ICL 2903/4 systems is expected to be available later this year.

## Why Ellerman replaced proprietary TP monitor after two years

THE deficiencies of ICL's online systems philosophy are cited by Ellerman Lines, the shipping firm, as the immediate reason for its decision to replace a proprietary TP monitor just two years after first installing it.

At the heart of the problem is the roll-in/roll-out mechanism advocated by the company for use under MTS on its small 2904 miniframes.

Ellerman Lines two years ago bought two 2904s, which serve three remote sites through a 7502 controller. At the same time it bought Zeus Hermes Cortex TP monitor, to support anticipated high-volume TP applications.

Low-volume inquiry routines were to be implemented as stand-alone programs under MTS.

However with four such programs implemented, the company found that the query response time varied unpredictably when batch work was running, rising on occasion to as much as a minute. This was attributed to the roll-on/roll-out overhead.

The only way to achieve a predictable response time was to lock the inquiry programs in place. With a total of eight inquiry programs projected, this approach was ruled out because of the cost of buying the extra store required.

Instead, the firm decided to adopt a single program approach, using overlays, while at the same time installing Telecomputing's TPS. A major factor was the performance

improvement possible using a multi-threading TP monitor.

"Having decided to change our approach, and taking into account our projected workload, performance was the critical factor," said a spokesman.

"We wanted to put out TP on the most efficient basis possible."

"We found Cortex an excellent environment for developing TP applications. The version we have, however, is not multi-threading and I don't regard the enhanced software, Cortex-Plus, as a true multi-threading monitor either."

"It is actually a multi-leaving system, permitting tasks to be interrupted. Moreover, these facilities have to be built into the application, and are not handled automatically by the monitor."

The spokesman explained

that another factor in the decision to convert to TPS was Ellerman Lines' need to install an online program development system. Telecomputing's new active Operator (Software Release October 13, 1977) could be used to TPS with only a slight additional overhead.

A spokesman for Zeus Hermes regretted that the company had not been able to examine the projected TPS workload. "One question is whether the plans are feasible under a TP system."

"Assuming that they are, there are many approaches to improving system performance, for example tuning the message router. I am sure we could have sorted out the problems given the chance."

## Councils to use US vehicle fleet management system

A US-developed vehicle fleet management system has been acquired by the Local Government Operational Research Unit, LGORU, for future use by local authorities in the UK. The software may also be sold to other ICL miniframe users.

Called Fleet Management Package, the software serves the needs of transport and workshop managers for information on vehicle life, repairs, fuel consumption, and preventative maintenance.

It was developed by Public

Technology Inc, one of LGORU's partners in the International Urban Technology Exchange Program.

LGORU acquired UK and European marketing rights to the software after investigation revealed that no similar package was currently available. It has entered an agreement with ICL for sales to ICL users.

First user of the system will be Northumberland County Council, which will implement an existing IBM version.

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## SOFTWARE FILE -2

# Chance to find out what APL can provide

"THE simplest, most effective, and most enjoyable way to find out what APL can offer" is how the APL User Group describes a meeting to be held in London this Friday, November 10. Due to speak is Al Rose, one of the world's foremost exponents of the language.

Rose, one of the founders of the Scientific Timesharing Corp, will give his one-day "Introduction to APL" in the Read Lecture Theatre at Imperial College.

The same venue has been

chosen for an afternoon presentation just one week later by Ian Sharp, head of the other major APL timesharing company, I. P. Sharp Associates. Sharp will speak on November 17 on APL, communications, and the development of APL over the next ten years.

Those wishing to attend on either day should contact Peter Cytex at ICL Datasoft (Reading RG2 398) or Mike Goodall at Ciba-Geigy (Horsham H0101). The UK APL User Group is a specialist group of the British Computer Society.

## PROGRAMMER NOTES

# Shortage of expertise threat to growth of electronics

"PROGRAMMING is a craft, more akin to weaving baskets and carving ivory statues than to assembly labour."

These are the colourful analogies used by an American electronics expert while addressing the Electronic Industries Association of Japan in Tokyo last month.

Earle Jones, of SRI International (formerly Stanford Research Institute), was seeking to explain that shortage of software expertise could limit the growth of electronics in the 1980s more than any other single factor.

His statement on programming is neatly echoed in the opening sections of a recently published book, "Studies for Programmers", which is squarely aimed at developing "craftsmen" programmers.

Essentially a collection of programming exercises, it is intended primarily as a source book for programming course instructors.

The problems, which are sizeable, are placed by the author in the context of the classic apprenticeship. "They are suitable," he says, "as training projects for the novice programmer who wishes to become first a journeyman and then a master."

He disclaims, however, any attempt to teach specific programming techniques, data structures, or languages. The book also avoids discussing any particular programming style or structured programming method.

Of the 28 problems presented, many arise from the two areas of games and computer science, and although only two full solutions are given, a bibliography is provided which will often suggest an approach.

An original idea, it has been turned into a clear, inviting, and informative text by its author, who teaches at the David campus of the University of California. It will be found both enjoyable and instructive by anyone keen to extend their programming skills.

"Studies for Programmers, by Charles Wetherell, pp.200, published by Prentice-Hall, £5.95.

## Correction

A TYPOGRAPHICAL error occurred at a key point in Jon Krigg's article on microcode (Software Techniques, CW, October 28). The second paragraph on p.34 should have begun with the sentence: "In the same way that a program is a sequence of instructions, a micro-program is a sequence of micro-instructions."

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*Appl. 1720*



## OP SPOT

# A package for program function keys under DOS

PROGRAM function keys, which often save IBM OS/VS operators much unnecessary typing (Op Spot, CW August 17), may be used to similar effect in the DOS and DOS/VS environments.

The software package which makes this possible is called Logout and is available from Micro 4, a software house in Wallington, Surrey.

This piece of information will be of particular interest to the shift leader who contacted me a while back to discuss PFKs in relation to his system, an IBM 370/138, under DOS/VS, Release 34.

In a letter to Op Spot Keith Piper, a programmer at Micro 4, explains:

"Logout operates with any standard, unmodified, DOS/VS supervisor and does not entail



Piper

renaming or changing job control, attention routine or any other IBM supplied component."

With Logout the keys are defined at IPL, or load, time and may not be modified online.

Continues Piper, "Logout will display the text associated with each key but, quite deliberately, does not allow the text to be altered. After some discussion, we decided that setting the values at IPL time gave the flexibility needed, without the risk of accidental alteration."

Each key may be assigned up to 30 characters and the text modified before submission.

Says Piper, "The text may represent a complete input message or just a prefix to a message. Since Logout PFK support operates by adding the text to the beginning of any input typed by the operator, the concepts are identical." He gives the following explanation:

"The user includes these

specifications:  
"...PF6='D RDR',PF12=MSG F2,...."

"Now to enter D RDR, FREE (a commonly used POWER/VS command) the operator types FREE and hits PF6."

"The attention routine displays 'D RDR, FREE' and processes the command as required. To enter 'MSG F2', he simply hits PF12."

Other features include:  
Timestamping each message on the log (in a Virtual Machine environment the CPU-ID is included).

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## The 810, end of throughput bottlenecks

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By Bernard Allen

### HINT OF THE WEEK

## Check all job control cards yourself

BEFORE feeding a large batch job (in terms of the number of data cards submitted) into the card reader, scan the deck for any errors in job control syntax. In this way it might be possible to prevent the job being flushed by the system as the result of an error.

Now some might contend that it is the responsibility of the job control section to check the cards in this manner but, to me, that is a

weak argument.

Firstly, a lot of time is wasted in sending the job back to the control section for correction.

Secondly, the unfortunate operator will have to re-read the job to the system, anyway.

Thirdly, by examining the decks in this manner the operator will become adept at spotting errors and will add to his expertise.

## Queueing listfiles on same printer

THE George 3 operating system will sometimes offer a number of alternative solutions to an operations problem, providing staff are willing to make use of its facilities and employ their own technical expertise.

I say this after considering some comments from Geoff Westcott, a programmer and former senior operator. He writes to Op Spot in response to a letter from Roy Cosway, senior systems programmer at the Truro site of Cornwall County Council (Op Spot, CW October 12).

Cosway called for better communication between operations and programming, and gave an example of what this can achieve. He described a situation in which George 3 intends to print payslips on two printers, simultaneously, but the operators want only one unit to be used for that purpose.

He went on to explain how the system programmers, once they knew about the problem, were able to make a small change to the operating system and save the operators a lot of typing at the console.

Now Westcott feels that altering the operating system is "rather complicated" and puts

forward an alternative solution. "When I was an operator I had a PROPERTY card ONELP, which was set as PERMANENT, INCLUSIVE. He gives the coding:

- 1) PR ONELP (PERM, INCL)
- 2) AU 14, PRONELP

According to Westcott, PROPERTY may be used to good effect when it is used to list more than one file: special stationery, using just a printer. He gives an example:

- 1) LF PAY1, \*LP, PRONELP & ONELP
- 2) LF PAY2, \*LP, PRONELP & ONELP

Says Westcott, "This is only one of the possibilities. PROPERTY attributes both listfiles will be queued to the same printer and the request to load payslips is issued."

Pointing to the reason for specifying INCLUSIVE, he says, "Listfile control, which does not request the PROPERTY may also make use of the printer to which it is attributed."

## Where do I go from here?

IN the absence of established career paths for operations people, more and more staff are becoming aware of the need to use their own initiative to secure positions where they can make use of their hard-won skills.

In this regard a senior operator from Staffordshire writes, "I have five years' operations experience in a large real time environment. I am looking to further my career but do not want to move out of operations."

Apparently he has seen an advertisement for an operations analyst, and asks, "Do you have any information about this kind of position? The only requirement specified was that the applicant needs to have a strong personality."

Well, such positions exist, but cause certain enlightened situations are aware of the experience and technical expertise that operations staff can offer.

Now most support staff for a thorough understanding of hardware or software or in this instance the need for "strong personality" is a requirement which implies that the work will involve investigating errors and dealing directly with users.

But without knowing the site concerned, the advice I can give is this: go for an interview and find out exactly what the work entails. If you feel the job is for you, look elsewhere.

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## COMPUTER ROOM. PLEASE ENTER VIA YOUR OWN TERMINAL

As a DP manager, you're probably more aware than most of the great computer paradox.

On the one hand, your system is designed to cope with vast quantities of work, and to save people time.

But on the other hand, there's you. Overworked. And spending so much time updating and modifying old programs, you've hardly any time for innovation.

Which is precisely why IBM developed the System/38.

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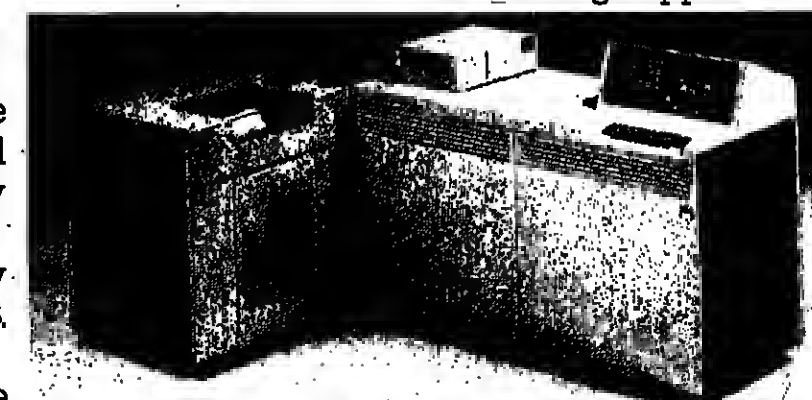
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# RELATIONAL DATABASES Part 3

## How fourth normal form files can be constructed

THIS week we will define fourth normal form files and show how they can be constructed.

**Relational Files.** In conventional file design, one value of the key field (or fields) uniquely identifies one record. In files designed using relational database principles, each file has a key (or keys) which correspond to the more precise definitions given in Part 2. The following rules apply to such files:

- Each key data item (or concatenation of data items) in a file has either an n-to-1 or a 1-to-1 relationship with every non-key data item in that file.
  - Each non-key data item in a file depends upon (each) key item. If a key is a concatenated key, each data item not within that key depends upon the whole key and not just part of the key.
  - Each non-key data item in a file is not related to any other non-key data item in that file.
  - If a key is a concatenated key, each item within the key participates in an indirect relationship. The meaning of an indirect relationship is discussed later in this series.
- Note again that a file may have more than one key and such keys may be concatenated keys. These rules can be summarised succinctly (if not entirely accurately) by the following aphorism: "Each non-key data item depends upon the key, the whole key, and nothing but the key."

Corollaries of the four rules are that in each file:

1. There are no repeating groups.
2. Each non-key data item depends upon the key or keys. If the key is a concatenated key, the non-key data item depends upon the entire key but not on any part of the key; no part of such a key is redundant. This is called "full" dependence and the key is called a "full" key. If there is more than one concatenated key, each item within each key depends fully upon each other key.
3. No data item depends upon a key in another (non-key) data item.
4. No data item which is part of a concatenated key is unrelated in any of the remaining data items in that key.

**Normal Forms.** A file which satisfies corollary 1 is said to be in first normal form. A file which satisfies corollaries 1 and 2 is said to be in second normal form. A file which satisfies corollaries 1, 2 and 3 is said to be in third normal form. A file which satisfies corollaries 1, 2, 3 and 4 is said to be in fourth normal form.

Note that files in any of the normal forms may have only one record type.

**Direct and indirect keys.** A non-key data item which satisfies corollary 3 is said to be directly dependent upon the key, and the key is said to be a direct key for that data item.

A data item which depends upon a key via one or more intermediary data items is said to be indirectly dependent upon the key, and the key is called an indirect key for that data item.

Example: In the relationship diagram in Part 2, ORDER-NO is a direct key for CUSTOMER and an indirect key (via CUSTOMER) for SALESMAN.

**Candidate keys.** If a data item C depends upon a data item A and also upon another data item B (and if A and B are related), A and B are said to be candidate keys for C. Note that A and B do not merely form a concatenated key for C; either A or B alone is a key for C, A and B are in a 1-to-1 relationship.

Example: If Figure 1, Part 1, had an ITEM-CODE field as well as ITEM and ITEM-CODE would be unique to a particular ITEM, both ITEM and ITEM-CODE would be candidate keys for DESCRIPTION.

Performance considerations apart, fourth normal form (FN4) files represent an ideal file structure, and the notion of candidate keys leads to a precise definition for such files. Since there may



By Max Stewart

This is the third in a 10-part tutorial series on databases and structured file design, by Max Stewart, the divisional technical support manager for Leyland Vehicles, the commercial vehicle division of BL.

now be some confusion between the term "key" and "the key of a file", let us redefine the meanings of candidate key and FN4 file as follows:

- A candidate key is a key (possibly a concatenated key) which is a direct full key for every other data item in a file. Each key value uniquely identifies a record within the file.
- A file is in fourth normal form if it has no repeating groups, if every direct full key is a candidate key, and if every concatenated candidate key contains an indirect relationship which includes all members of the key.

**Creation of FN4 files.** The process now to be described can be used to create FN4 files from a collection of data items after drawing the relationship diagram. Remember that in a relationship diagram a key is either on the "n" (arrowed) side of an n-to-1 relationship or on one side of a 1-to-1 relationship.

Step 1. Select a data item which is a key (or data items which together form a concatenated key select all of them). The selected key (which may be a concatenation of data items) is called the prime key (strictly the prime candidate key). If two or more data items (or concatenations of items) are candidate keys, arbitrarily select one as the prime key. The remainder are called non-prime keys.

Step 2. Select those other data items which depend directly and fully upon the prime key. This includes any non-prime candidate keys. If a non-key data item depends upon the key data item in more than one relationship (eg if in Figure 1, Part 1, there were two types of salesman — a "perishable" salesman and a "non-perishable" salesman — and a customer were allocated one salesman of each type), both data items can be considered to be available for selection as many times as there are relationships.

Step 3. Construct a file which has the prime key as a key field and has the selected dependent data items as non-key fields.

Repeat these steps for each key (or concatenated key) which has not already been selected as a prime or non-prime key. Note that if an item is selected as part of a concatenated key, it is still available for selection later in its own right or as part of a different concatenated key.

After these steps have been completed, there may still be unselected data items. These can either be unrelated to any other item (in which case they form a file of their own — really just a list of values); or in an n-to-n relationship with one or more other data items. The following step should be applied to each pair of such data items in which each item in the pair is unrelated to any other unselected data item apart from its partner (ie is in the simple type of n-to-n relationship which was introduced in Part 2). More complex n-to-n relationships can exist but are unusual. Rules for dealing with them will be discussed in a later article.

Step 4. For each simple n-to-n pair, construct a file with the pair as concatenated key and with no other data items in the file.

Finally, examine each file in turn and delete records which are duplicated within any one file.

These steps look formidable in cold print but are simpler to perform than to explain. Remember that most of the time we are just picking out keys and clustering each key together with its dependent data items into a simple file.

Part 4 will include a demonstration of this process and will discuss some of the advantages of FN4 files.

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## Role of the Microform Specialist Group

THE Microform Specialist Group, MSG, is a somewhat hybrid organisation supported by specialists from the computer and microfilm fields.

Some years ago the introduction of computer output microfilm caught the attention of a number of BCS members who felt that the potential of this new technology justified the type of closer study which a BCS Specialist Group makes possible.

In the first year of its life the MSG spent much of its time in the mutual education of

more complex issues such as "holographic storage of microfilm". The output of computer data on to microforms ( fiche and film) and the entry of data from microfilm into the MSG sees some for more very worthwhile work. The new microprocessing devices, the quest for an alternative film to compete with VDU's (avoiding wet processing) — these and many other questions beckon us.

BCS 79's theme, "Living with Computers" fits naturally into the MSG activities. At the event, on the morning of Friday, January 5, an educational and challenge programme will be offered to the group. There will be three presentations chaired by Ron Fiddes, of the UK Central Computer Agency. The first by John Spencer, of Shell Ltd, will be set the scene by covering the history and development of Computer Output Microfilm. This will be followed by Malcolm Lewis (Maticom) talk on the future COM as he sees it. The second presentation is designed specially for the software enthusiast and will be led by



Ron Fiddes, chairman of the BCS Microform Specialist Group.

microfilm and computer technologists and then set out to provide basic introductory talks to the public through seminars.

This basic approach to its activities has continued, though nowadays early questions such as "How does data film work" have given way to

## Prime developments

COMMUNICATIONS software for the Agricultural Research Council's Honeywell 710 front-end processors at Rothamsted.

The Computer Department at Rothamsted will use Compu-Pascal and Prime Pascal Assembler on the 235,000 user. Prima system in use at Rothamsted with its participation in EPSS and its plans to use as well as new facilities for leased line and data-up links.

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## Managers and unions come to grips with the automated secretary

AN important aspect of word processing is that it affects a goodly number of ordinary workers — secretaries and typists — directly, while data processing has largely been done behind closed doors by specialists.

So the human problems involved in introducing it can be formidable, and this was confirmed by the number of people, more than 90, at Information Studies' conference in London last week on "Word Processing — the Human Dimension."

On the platform were several well-known pioneers in the introduction of word processing, who came to describe their experiences and give their advice.

Management was one of the key issues at the conference — particularly the way in which typing services are organised. Shirley Pickard from ICI Plastics, and Irene Harford from Mussey-Ferguson, both described how their firms had got rid of large numbers of individual managers' secretaries and grouped them into "bureaux" of six or so each, sharing typing and other secretarial duties between them.

Many managers were reluctant to give up their "office wives," and central facilities had to be set up to handle such peripheral jobs as tea-making (that the secretaries hitherto had carried out).

Word processing screens were then installed in the secretarial bureaux, with generally good results. It was agreed by the speakers that word processors were not cost-effective when provided to individual secretaries, however attractive the machines might be, because that would entail expensive capital equipment lying idle much of the time. It could be useful, however, to give them to managing directors' secretaries, in order to convince the MD of the value of the concept.

Pat Coen, as both supplier and user of WP, emphasised the advantages of shared logic systems with regard to centralised management. Shared logic places under the direct control of the supervisor all purging of files, making of security copies, linking to other systems and other input media such as OCR, and so on. This, he claimed, contributes greatly to productivity. However, he added, changing the organisational structure at the same time as introducing WP could lead to trouble, as people could only adapt themselves so much at a time.

One cri de coeur that came from all the women on the panel was over the falling standards of spelling and grammar of the typists now coming to them from school.

Doris Lenson, who at the Automobile Association was a pioneer of WP and is now an independent consultant, described how she set up training courses and daily spelling and grammar tests at the AA in order to fight this problem.

Asked about the need for outlying word processing centre where the typists would be produced and typed output could be produced off-site, also in London. Editing terminals could also be provided in the London Office for ease of making changes.

Irene Harford described a country-wide network already being set up by Mussey-Ferguson to link its secretarial offices and factories. This would be used by word processors to communicate directly with each other, and also for other purposes such as facsimile and Telex.

A centralised dictating system in the London office could send dictation by telephone to the

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An added attraction was Barrie Sherman of ASTMS, there to give a "Trade Union perspective."

"The unions don't have a view on word processing yet (because up to this year the TUC didn't know a silicon chip from a chip but) but this doesn't excuse you from not having a view on the unions," he said.

Things will start to happen soon, Sherman asserted, especially after next April's TUC conference on microelectronics, and as productivity is increased by word processors, more and more unions will be saying "We want a share."

(This led Logica's Pat Coen to remark with a grin that he was happy to take orders now from people wanting to get their systems in before next April.)

Sherman claimed that union penetration in the clerical area of the private sector, as yet very weak, would soon be growing to catch up with the public sector, and with government action on industrial democracy, this would bring about plenty of

union control over the introduction of word processing.

He was also scathing of the Prime Minister's notion that the service industries could absorb the unemployment caused by automation in manufacturing.

The principal product of the service industries is information, Sherman pointed out, and office automation would bring about plenty of unemployment there.

"There is no way," he said, "that a Birmingham typist can become a health worker in Wigan."

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word processing training at colleges, Lenson replied, "For God's sake let's get the 3 Rs right first."

There was much discussion — and disagreement — at the conference on the design of WP equipment regarding ease of use: the way cursors should move on a screen, and so forth. Tom Stewart, ergonomist from Loughborough University, emphasised the importance of adjustability of screens and keyboards, and the tricky problem of eyestrain.

Gordon Ross, from the Department of Industry's Work Research Unit, raised the issue that introduction of word processing could cause problems with career development structures. He also suggested that work rotation could increase satisfaction, in operating printers and the like.

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Pat Coen, as both supplier and user of WP, emphasised the advantages of shared logic systems with regard to centralised management. Shared logic places under the direct control of the supervisor all purging of files, making of security copies, linking to other systems and other input media such as OCR, and so on. This, he claimed, contributes greatly to productivity. However, he added, changing the organisational structure at the same time as introducing WP could lead to trouble, as people could only adapt themselves so much at a time.

One cri de coeur that came from all the women on the panel was over the falling standards of spelling and grammar of the typists now coming to them from school.

Doris Lenson, who at the Automobile Association was a pioneer of WP and is now an independent consultant, described how she set up training courses and daily spelling and grammar tests at the AA in order to fight this problem.

Asked about the need for outlying word processing centre where the typists would be produced and typed output could be produced off-site, also in London. Editing terminals could also be provided in the London Office for ease of making changes.

Irene Harford described a country-wide network already being set up by Mussey-Ferguson to link its secretarial offices and factories. This would be used by word processors to communicate directly with each other, and also for other purposes such as facsimile and Telex.

A centralised dictating system in the London office could send dictation by telephone to the

Frank Jones from Bradford City Council claimed to have saved £59,000 a year and cut typing staff from 44 to 22 with his Wordplex 7 system.

An added attraction was Barrie Sherman of ASTMS, there to give a "Trade Union perspective."

"The unions don't have a view on word processing yet (because up to this year the TUC didn't know a silicon chip from a chip but) but this doesn't excuse you from not having a view on the unions," he said.

Things will start to happen soon, Sherman asserted, especially after next April's TUC conference on microelectronics, and as productivity is increased by word processors, more and more unions will be saying "We want a share."

(This led Logica's Pat Coen to remark with a grin that he was happy to take orders now from people wanting to get their systems in before next April.)



# IPC bureau's view of an upgrade to a 2900

LIKE any ICL user, Computer Data Processing Ltd, the company which operates primarily as an in-house bureau for the International Publishing Corporation, is faced with the problem of where to go from its twin System 4/72 mainframes.

Plans are to move to DME System 3 on 2960 as an interim step to VME/B. Initially the 2960 will be run under DME for two shifts, switching to development under VME/B for the prime shift, so that one System 4 can go next summer. Later, the other System 4 is likely to be replaced by a larger 2900.

One System 4 is on long lease from ICL, and the other on long lease from a finance company. With ICL no longer offering this kind of lease, the new machines will be third-party financed.

Some preliminary work towards the changeover has already been done.

"We sent a group of operators

to Dalkeith with what we regarded as a typical one-shift DME workload to run benchmarks on a 2960, and the results were encouraging," Ted Piper, managing director of CDP, told Computer Weekly. "The 2960 processor is less powerful than the 4/72, but the loss on computer-bound jobs is largely outweighed by the significantly faster input-output. However, under VME/B the comparison is less good because, for example, there is much more communications overhead under VME/B than under System 4 J." He also mentioned I/O error correction under VME/B which takes up two to three times as many processor cycles as it does under J.

Piper had a word of warning for users lulled into a sense of false security about the ease of transferring workloads from native machines to DME.

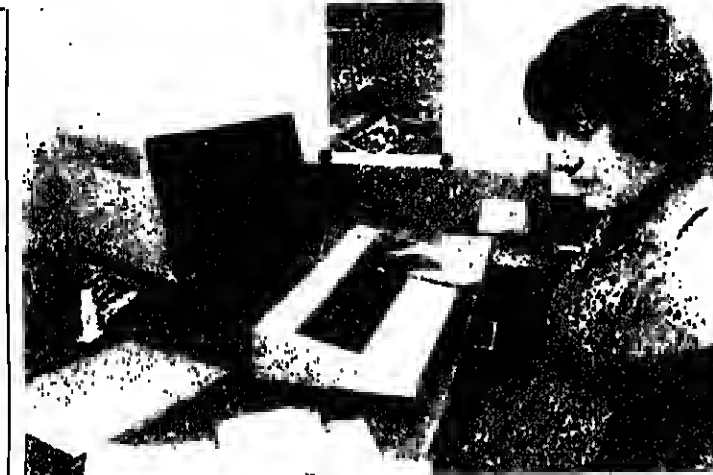
"It is only true to say that no

modifications to programs are required if you transfer to a machine with an identical configuration to your System 4. But if you want to take advantage of things like denser discs, which any user is likely to want, then some conversion is involved.

"It also appears that any programs written under an earlier release than J1800 have to be recompiled before they will run under DME."

"We have just about completed the task of identifying the system which will represent the half of our System 4 workload which we transfer to the 2960, but we have not yet calculated the effort which will be required to do the conversion. For example, there may be tape-based systems which we want to convert to discs."

Nevertheless the advantages of DME are underlined by a further assessment made at CDP.



One of LWT's accounting staff inputs details of expenses to the Nixdorf 8870.

## Nixdorf speeds accounts at TV studios

UPDATING from a semi-manual accounting system to an online system, London Weekend Television has installed a Nixdorf 8870 to replace the NCR 33 ledger card accounting machines previously used.

The 8870, chosen in preference to an outside bureau service, will enable LWT's accounts department to handle over 3,000 purchase invoices and about 2,000 journal entries a month.

Special software has been written to manage payments to artists for work on productions in the LWT studios.

The LWT system consists of a model N 8870 processor, five VDI's, and 30 Mbytes of disc storage. Another 30 Mbytes of disc will be added later, and it operates under Nixdorf's Comet accounting package.

## Recognition fight

A ONE-DAY stoppage was called at British Aerospace's Chester computer centre last Friday by members of APEX who are seeking recognition from the company (CW, November 2). The other established union there, TASS, has said that it will not interfere in the APEX claim, which refers to staff at BAC's Kingston site and those seconded to Chester from there, unless APEX attempts to gain recognition among all staff at Chester.

## Datacoms study

NEARLY 4,000 firms in Europe will soon be contacted to determine their level of data communications usage, for the Eurodata 78 study commissioned earlier this year from Logica (CW, March 9).

## LETTERS TO THE EDITOR

### Voting rights in the BCS

IN a recent issue (CW, October 19), Mr David Allen, the secretary of the Kingston Branch of the BCS, is quoted as saying that "We want full membership with voting rights for such experienced staff, not merely affiliate status as at present."

As a branch officer, he is surely aware that the only members of the Society who do not have voting rights are students and persons more than four months in arrears with subscriptions. Perhaps Mr Allen is confusing voting rights with eligibility for election to Council, which is restricted to Members and Fellows.

BCS London

### Market share of graphics business

AN item (CW, October 26) raises an interesting mathematical (not to mention marketing) problem. In it you state that the combined operations of Benson and the graphics division of Varian, which Benson has just acquired, are "about half the size of Colson's graphics division."

You preface this by saying that Benson has "won 50% of the European market for graphics peripherals" and then go on to say that their turnover last year was about \$10 million, worldwide.

When one considers that, according to their recently published report and accounts, Colson's turnover in Europe

alone was more than \$18 million last year at \$22 million, which \$10 million of graphics peripherals can give Benson a 20% share.

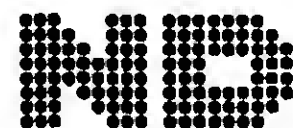
Admittedly, this is something a little more than \$18 million, but while to other plotter manufacturers like CIL, Konigheite, Houston Gerber, etc. name a few?

According to their last year's figures, they didn't do as well.

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## MICRO NEWS VISITS NATIONAL SEMICONDUCTOR IN CALIFORNIA

These days the microprocessor means more than just the "chip", now so much in vogue in the national Press. The semiconductor companies know that the fundamental key to the marketplace is not just technological development with hardware, but also considerable strength in software. In common with other manufacturers, National Semiconductor is pushing both aspects with equal vigour.

Howard Raphael, National's microprocessor marketing director, spoke to Micro News editor MARTIN BANKS at the company's world headquarters in Santa Clara, California, about its planned developments in the 16-bit processor market, and in high level language support — in particular, the support of Pascal.



World headquarters of National Semiconductor in Santa Clara, soon to become another base for the support of Pascal as an important high level language for 16-bit microprocessors.

## Now National opts for Pascal, the people's language

PASCAL, already christened by some in the US as the "people's language" seemed set to become a real force in the world of complex microprocessors over the next two years. During this time, the new ranges of 16-bit devices will start coming on to the market in volume, and another major manufacturer entering the fray, National Semiconductor, is gearing itself to support the language.

The device on which it will run has yet, officially, to receive a designation, but according to Howard Raphael, microprocessor marketing director with National, the company is committing itself to the support of the language on a 16-bit micro that will be broadly similar both to Zilog's Z8000 and Motorola's 68000 devices.

The company is pursuing developments on both the 16-bit and 8-bit front, making use of its X MOS process. This, like the HMOS now being used by Intel, uses a scaling process to reduce component geometries. This makes use of the photolithographic techniques that are a fundamental part of semiconductor manufacturing at present, photographically reducing the physical size of the chips produced.

Raphael was keen to point out that National's development efforts were predominantly geared to producing what he referred to as "third generation" devices, both in the 16-bit and 8-bit arenas. Though he would say little about the 8-bit development work, beyond the fact that some announcement "was a possibility", he was more willing to talk about the company's plans in the third generation 16-bit marketplace.

The X MOS-processed device has already been scheduled for a launch during the first half of 1979, and will have several characteristics in common with the other complex 16-bit processors that have launch dates coming up.

It will, for example, be able to address a significant amount of memory directly, though Raphael would not be drawn on how much, and it will feature 32 bit characteristics. Again Raphael would not be drawn, but this seems to be a reference to 32-bit memory addressing, while functioning on 16-bit data. The overall concept of the device was set out by Raphael in these words: "The third generation microprocessors should be a combination of current computer architecture and the advances that are possible through technological development. Where necessary, they should also include some of these characteristics already developed for 8-bit devices."

He suggested that National's entry into the fray would produce a device with between 10 and 20 times the performance of currently available 8-bit microprocessors.

National seems to be following a line between the Intel

approach to the 16-bit market with its 8086 part, and Zilog, with the Z8000. The National device, according to Raphael, will require a limited number of new peripheral devices. In particular, there will be a requirement for a memory management device.

Thus far the company tracks the route being trod by Zilog. The new part will, however, still be dependent to a considerable degree on the peripheral chips already available for National's second source 8080 microprocessor, "to protect", as Raphael puts it, "our investment in these products."

This is an area where National is already heavily committed. Though it is only a second source supplier of the Intel pro-

cessor chip, it now claims to have a larger selection of peripheral devices available for use with the part than Intel.

In general terms, Raphael now divides the micro market into distinct sectors. These start with what he defines as the very low end, which covers the low cost microcontroller area where devices sell in the \$1 to \$3 price range. This is followed by the low end market, which he defines as being those systems with less than 4K of memory, a strong I/O orientation, and a chip count of less than six devices.

The biggest single market area Raphael calls the mid-range. Taking about 50% of the total microprocessor systems market, this is given over to the 8080, Z80 and 6800 family of processors, usually with between 8 and 12K bytes of memory.

The final two sectors, which are by no means the largest, but of growing interest to National, are the high end market, and the bit slice market. The former, which Raphael says covers applications requiring large memory systems, is of obvious interest with the forthcoming introduction of its own new 16-bit part.

The bit slice market, where National both second sources the AMD 2900 family and produces its own versions of the part, is small, but is growing at about 20% a year at present, and is showing no signs of falling off, despite the

as yet, no real standardisation beyond the popularity of the San Diego Pascal.

He points to several reasons why the Pascal "movement" is gaining pace. One is directly geared to coming of the more powerful microprocessors. "Previous objections to high level languages on microcomputers have centred around the fact that they are code inefficient, and have little in the way of a real time capability," he said. "The new 16-bit devices, when they are on the market, will help to change this situation."

Another important reason for the move to Pascal, according to Raphael, is the ease of adaptation for people who have already learned to program in Basic.

Its other advantage, of course, is that it does offer a real time capability.

This move by National does not mean, however, that the

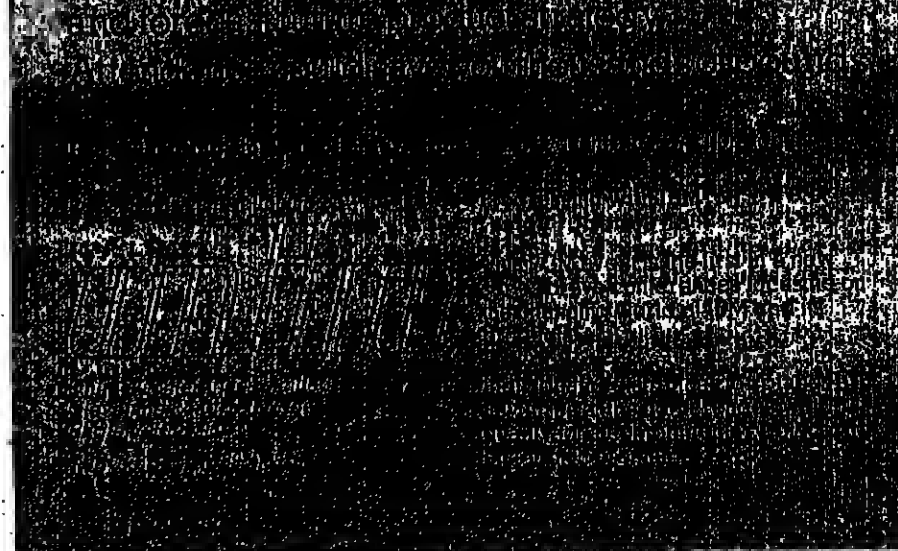
company will be diminishing its current software support operations with Basic and Fortran.

With Basic, for example, the company is currently gearing up to launch a version of its 64K ROM that will hold the Micro-Soft 8K byte Basic Interpreter as firmware. This will complement National's existing offering in the firmware market, a 32K ROM, holding National's own, 4K byte simple Basic, called NIBL.

This combination of developments in firmware modules, and increasing efforts in software support constitute a concerted attack by National on the cost of software generation. With Pascal, the company is pushing a frontal attack, trying to make high level languages more efficient, and with the firmware modules, it is moving towards the development of firmware applications packages.

## IBM. The alternatives...

A conference to examine IBM alternatives is being held at the IBM Research Center, Yorktown Heights, New York.



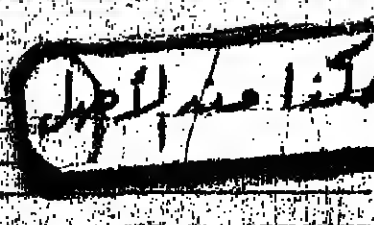
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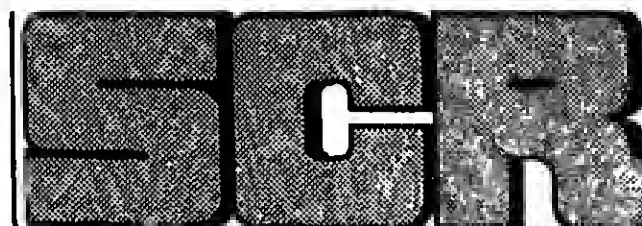
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GET AWAY FROM IT ALL! Work in beautiful surroundings. Our client is a systems analyst for a major commercial systems firm offering the possibility of travel through Europe plus F&M. TASTIC perks including an excellent sports and social club. REF: 1889

**LONDON to £4,500**  
ANALYST/PROG  
EXCITING opportunity for a programmer to be trained in a world leader in its technological field. Has a large IT network with links to Europe and they offer full training in database and TR. FANTASTIC prospects for PRO. REF: 1892

**W. LONDON to £8,500**  
SYSTEMS ANALYST  
MANAGEMENT CAN BE YOURS! Have you the ability to make practical contributions to business decisions at all levels and 2/3 years IBM systems analysis experience? If so, this highly successful international group would like to discuss your future, rapid career progression, generous benefits. REF: 1923

**CITY to £5,500**  
IBM JUNIOR PROGRAMMER  
IMPROVE YOUR CAREER! Special Do you find your present job dull and uninteresting? If you have around 12 months IBM DOS ASSEMBLER exp then this prestige organisation, which provides technical services to its clients, can give you the career you have been seeking. REF: 1905

**N. LONDON to £6,000**  
MINI PROGRAMMERS  
WHY TRAVEL to central London? Major group of companies based close to N. Circular seek programmers with VHSI/ASSEMBLER experience to work on real time systems on PDP11. Small project teams encourage involvement at all stages thus giving project experience and user contact. Excellent prospects in a friendly atmosphere. REF: 1918

**MIDDX to £10,000**  
+ PROFIT SHARE MANAGER  
DYNAMIC person required for responsible position involving full planning for and so to which is in publications systems design and management of 20 staff. Applicant should have experience of ICL range. REF: 1907

**CITY to £6,500**  
PL/I PROGRAMMERS  
SUPER opportunity awaits programmers with proven track record to improve career. They have IBM PL/I experience, they are with a major UK organisation - a major UK organisation. Financial environment REF: 1920

**HERTS to £6,500**  
PROGRAMMERS  
PROGRAMMERS required to work on a VAX RANGE of mini and mainframe control based applications. Current systems PDP and DG Nova hardware. Applicants should have 2 years experience of ASSEMBLER OR CORAL and/or RSX 11M would be advantageous. REF: 1908

01-734 0152

For further details telephone our London Office 01-734 0152 (24 hours)

## CONTRACT DIVISION

### LONDON + HOME COUNTIES

SYS PROG DOS VS CICS  
IBM COBOL/ASSEMBLER DOS  
IBM COBOL OS TSO + JCL COBOL  
IBM RPGII + COBOL DOS/VS  
IMS COBOL OR ASS OS AN/PROG  
ANALYST T.P. EXP  
CORAL COMPILER PDP II EXP PREF  
TEAM LEADER SASIC COMPILER  
PDP MACRO II + CDRAL PROG  
IMS PL/I DS/DC  
IBM OS PL/I  
2950 VMES D/BASE EXP PREF  
HONEYWELL EASYCODER  
AN/PROG IBM + ICL EXP COSOL  
SURROUGHS 6700 COBOL  
AN/PROG OS COSOL  
ICL 1900 GII

CITY £270 p.w.  
HERTS £220 p.w.  
HERTS £220 p.w.  
SUCKS £210 + p.w.  
KENT £220 p.w.  
E. LONDON £230 p.w.  
HERTS £230 p.w.  
HERTS £250 p.w.  
HERTS £230 p.w.  
CITY £240 p.w.  
W. COUNTRY £210 p.w.  
MIDDX £250 p.w.  
CITY £210 p.w.  
HERTS £220 p.w.  
SURREY £200 p.w.  
C. LONDON £220 p.w.  
C. LONDON £190 p.w.

### OVERSEAS

DUTCH SPEAKING PROGS  
IBM OS COBOL KN OF DUTCH  
PDP FORTRAN KN OF FRENCH  
ISM SERIES I ASSEMBLER  
PDP MACRO II RSXIIIM  
ISM OS COSOL SPSS  
IBM SYSTEMS PROGS OS/DOS  
PROGRAMMER 3790 EXP

HOLLAND £375 p.w.  
BELGIUM £375 p.w.  
BRUSSELS £380 p.w.  
HOLLAND £380 p.w.  
HOLLAND £400 p.w.  
HOLLAND £375 p.w.

FOR DETAILS OF THESE AND FUTURE CONTRACTS RING  
CHRISTINE KAY OR DAVE HAYTON - 01-734 0152 (24 HOURS).  
27 NOEL STREET, W1.  
OFFICES: Amsterdam, Paris, Manchester, Birmingham

## KNIGHT PROGRAMMING SUPPORT LIMITED

27 NOEL STREET, LONDON, W.1. TELEPHONE 01-734 0152/6 (24 HOURS)

OFFICES: AMSTERDAM, PARIS, MANCHESTER, BIRMINGHAM

Saudia, flag carrier of the Kingdom of Saudi Arabia, is seeking able and experienced staff to fill a number of challenging vacancies in its expanding Data Services Division, based in Jeddah.

### PROJECT MANAGER

Salary UK £13,300 pa - Tax free

The Project Manager will prepare the project plans, schedules and resource requirements, assist in the formulation of customer project objectives and feasibility. He will also be responsible for writing progress reports on the project and suggest recommendations accordingly. Applicants for this key post should have a university

degree or equivalent with at least six years' data processing experience including 3 years in programming and 3 years in systems analysis, and a minimum of 3 years of total experience performance with IBM 370/OS/VS 1, JCL tape disc or similar equipment systems. Previous airline experience an advantage. Dept: 120/2.

### SYSTEMS ANALYSTS

Salary UK £11,200 pa - Tax free

The successful candidates will determine the feasibility of customer requests and suggest actions as well as co-ordinate with the customer to determine the scope of the requirements, data input-output calculations etc. Assist in programme coding in COBOL and train programmers in the methodology of systems design and analysis. Applicants should have a minimum of 'A' level education with

at least four years' data processing experience, of which two in programming and two in computer systems design with a minimum of 2 years with IBM 370/OS JCL tape disc or equivalent machine systems. Airline experience preferred and in particular experience with Real-time Reservations systems using I PARS. Dept: 120/3.

### SENIOR SYSTEMS PROGRAMMERS

Salary UK £11,200 pa - Tax free

Candidates for these vacancies will assist the master systems programmers with IBM Operating system generation, maintenance, analysis and installation of IBM supplied fixes (PTF) and determine correction procedures for operating system faults.

Applicants should have GCE 'A' level education with at least 4 years' data processing experience of which 2 years in systems programming on IBM 370 OS/VS 1. IMS experience an advantage. Dept: 120/4.

### COMPUTER OPERATIONS ANALYST

Salary UK £11,200 pa - Tax free

Candidates for this position will work for the operations support group and will be required to work shifts. Duties include coverage of all production systems, on the job training of junior operators and systems maintenance and

monitoring. Applicants should have GCE 'A' level education with a minimum of 4 years' experience in the operation of IBM 370 hardware, of which 2 years have been in an operations support capacity. Dept: 120/5.

These posts, which are open to men between 25-45, are offered on a two year renewable contract together with free accommodation and free and reduced rate air tickets for you and your family. 40 calendar days vacation per annum plus relocation allowance.

Please write with full personnel details quoting job title and department number to:

Area Personnel Manager - Europe,  
Saudi Arabian Airlines,  
608/610 Chiswick High Road,  
London W4 5SQ.  
Closing Date: 24th November, 1978.



**saudia**  
SAUDI ARABIAN AIRLINES Member of IATA

### COMPUTER OPERATOR/SENIOR COMPUTER OPERATOR

The Computer Laboratory has a vacancy for an experienced Computer Operator/Senior Computer Operator. The Laboratory provides the central computing services for the University and associated Medical School using a Control Data Cyber 72 with a wide range of peripherals and a campus network based on DEC PDP 11s. Applications are invited from those with a sound knowledge of both RJE and interactive systems. Salary according to age and experience on a range two-shift allowance. Applications (closing date 30th November, 1978) should be made to the Director, Computer Laboratory, The University, Leicester LE1 7RH, telephone number (0533) 50000 extension 42.

### COMPUTER PERSONNEL APPOINTMENTS

PROGRAMMER/ANALYST  
TROUBLESHOOTING  
SALARY £4,000  
A young person (male/female) in College and Mini Computers to travel from Midlands to London for a period of 6 months. The position includes specification and development of new systems, programming and support to accounting staff. Early promotion is envisaged.

### SALES MANAGER

The company is an established leader in its field - data logging and computer peripherals. The job is based in the Cotswolds with extensive travel throughout the U.K. and occasionally overseas. Candidates should be aged from upper 30s. Further particulars and application forms may be obtained from the Regional Manager, University of Salford, Salford, Wiltshire, Wiltshire, Wiltshire, Wiltshire. Completed applications should be retained by 30th November 1978 quoting reference CL/58/CW.

### CHIEF PROGRAMMER

West of London c. £7,500  
This is a management position, ideally suited to an individual with a high level of motivation, self-reliance, initiative and training. Supervisory experience and leadership qualities are essential.

### SENIOR ANALYST

West of London c. £7,000  
A substantial multi-functional role requiring a systems analyst to join a team in the development of a new system. The role involves a high level of responsibility and leadership.

### SENIOR ANALYST

N. Surrey to £6,500  
Applicants should have a degree in a relevant field and 3 years' experience in a similar position. The role involves a high level of responsibility and leadership.

### ANALYST/PROGRAMMER (RPG II)

N.W.10 £6,500 +  
You will be involved with the development and maintenance of new and existing systems. Current systems include inventory control, invoicing, management information and accounting. Future plans are for on-line processing.

If you would like to be considered for any of the above vacancies, please phone for an Application Form. Alternatively, please phone for details of positions in your area of interest.

## AMES PERSONNEL

Employment Agency Suite 14, Dryden Chambers,  
119 Oxford Street, London, W1R 0PA. Tel: 01-434 1106

### UNIVERSITY OF SALFORD

### COMPUTING LABORATORY

### TWO VACANCIES

exist in the Applications and User Services Group which supports users on the University's ICL 1904S and PRIME computers, as well as their use of other machines in the North West. One will include development of application packages, particularly those with a graphics interface, giving programming advice, and some documentation work. Should a suitable candidate be available, one appointment will be made at the Grade II level, and will carry considerable responsibility for supervision of documentation, and other administrative duties, but both appointments may be made at the Grade IA level.

Salary £6317-£7754 (Grade II) or £3963-£5655 (Grade IA).

Further particulars and application forms may be obtained from the Regional Manager, University of Salford, Salford, Wiltshire, Wiltshire, Wiltshire. Completed applications should be retained by 30th November 1978 quoting reference CL/58/CW.

### CAPITAL APPTS.

### PORTMAN

Programmer/analyst required for industrial and scientific development. £2,000-£3,000 p.a. All areas. Please send cv to: Capital Appts, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000.

### COMPILE DESIGNERS

### COMPILERS & OPERATING SYSTEMS DESIGNERS & WRITERS, OXFORD

Our client requires a highly motivated and down-to-earth specialist in the design and development of advanced compiler and operating systems. The position involves a high level of responsibility and leadership. The client is a market leader in advanced systems and is looking for a highly motivated and down-to-earth specialist in the design and development of advanced compiler and operating systems. The position involves a high level of responsibility and leadership. The client is a market leader in advanced systems and is looking for a highly motivated and down-to-earth specialist in the design and development of advanced compiler and operating systems. The position involves a high level of responsibility and leadership. The client is a market leader in advanced systems and is looking for a highly motivated and down-to-earth specialist in the design and development of advanced compiler and operating systems. The position involves a high level of responsibility and leadership. 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